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# The Shrinking U.S. Military

## What to Do with the Excess Equipment

UP201RD1



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# Contents

# INTRODUCTION

This project was initiated in the fall of 1992 to examine the issue of what value stored equipment might have in a reconstitution scenario. In that scenario, forces were to be rebuilt over a 5 – 7 year period commencing sometime after the turn of the century, in the face of an emerging global threat. Early analysis showed that, with exceptions (e.g., Navy ships), it was difficult to justify storing large amounts of equipment to meet the requirements of such a buildup. Much of today's equipment becoming excess as the force shrinks is already obsolete (e.g., M60A3 tanks, A-7 aircraft) and would not likely be adequate against a presumably [illegible] global threat 10 years or so hence.

Now, however, the larger force reductions being sought by the new Administration raises a related but different issue — namely, what is the value of stored equipment for a rapid, nearer-term, limited buildup in the face of world circumstances short of the global threat scenario? We believe this to be a legitimate issue since, as the force levels shrink below the Base Force, the risk increases that the remaining force structure will be less than that needed to support our national security objectives and our military strategy. Further, the equipment becoming excess as the force drops below the Base Force should, for the most part, be relatively modern and effective in the nearer-term, especially against nonglobal adversaries. This paper addresses that redefined issue.

# SUMMARY AND RECOMMENDATIONS

This paper focuses on the equipment becoming excess[1] as a result of the force downsizing, specifically as a resource for any force expansion that may be required within the next ten years or so. Once decisions are reached regarding steady state force levels and force mixes, it will be possible to quantify the actual amounts of equipment to be made available. In the meantime, we can address the issue in general terms. We believe that the greatest utility in this stored equipment is in its potential use to quickly rebuild limited forces.

While the case for storage of equipment is attractive, especially to build back up to the Base Force levels, the higher costs associated with storing and maintaining equipment specifically for reconstituting to the even larger, pre-Base Force levels are harder to justify, given the lower probability, and therefore low risks associated with the emergence of a global threat within the next ten years. Rather, the need to rebuild forces to meet one or several nonglobal contingencies, perhaps only as a deterrent, in the next ten years or so is more likely than the

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[1] We use the term "excess" to refer to equipment that is excess to the requirements (including authorized levels of war reserves) of the total force, not just the active force. Equipment becoming excess to the active force is first being made available to satisfy requirements of the Reserve Components. It is the equipment excess to the Reserve Components' requirements that is then available for storage programs.

global threat scenario, and some equipment probably should be set aside to provide such a quick incremental growth capability.

Figure 1 illustrates the situation by depicting a return to the Base Force levels after a drawdown to the Option C[2] levels. Any such buildup would likely be accomplished much more quickly if stored equipment were available. (Fortunately, the use of stored equipment is not mutually exclusive with new production: an initial capability could be achieved quickly using stored equipment and force modernization could subsequently occur as the new production items become available.) A return to even higher levels (e.g., back to the FY89 levels) using stored equipment would not be as attractive, since doing so would require using the oldest and least capable of the excess equipment.

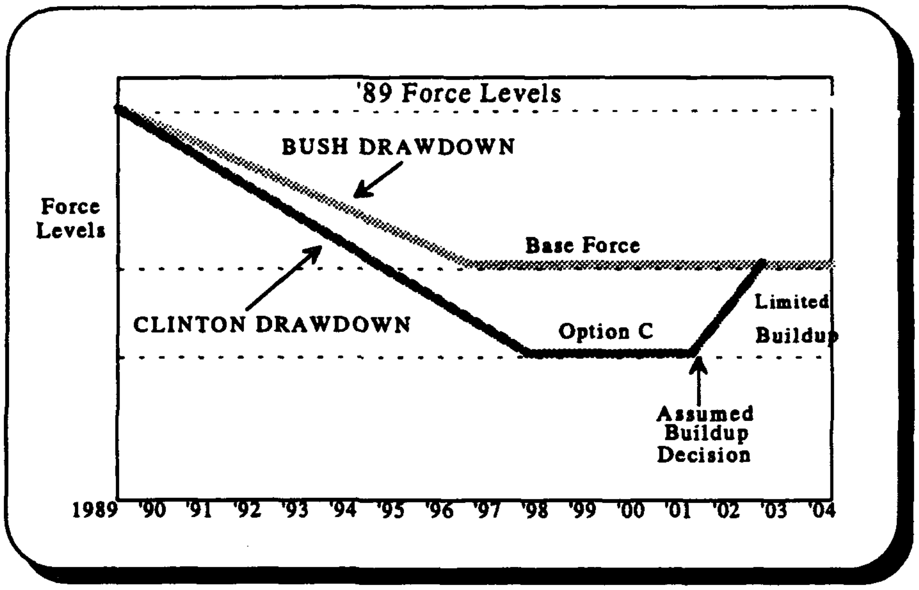



**Figure 1.**
***A RETURN TO THE BASE FORCE LEVELS***

Our analysis of this issue leads to two basic policy options. The first is to continue with the status quo, which is to say with very little, and somewhat outdated, DoD-level guidance regarding the retention of excess equipment for force expansion purposes. The existing guidance (i.e., in the most recent Defense Planning Guidance) is set in the context of a reconstitution, defined by the emergence of a global threat arising in the distant future, with a lengthy period available to build the required new forces. As a consequence, it is not surprising to find that the Services have (with the exception of Navy ships) little inclination to spend scarce dollars for the preservation and storage of excess equipment for force expansion purposes. Under the guidance given, they legitimately can decide

[2] Option C is an alternative force level proposed last year by Congressman (now Secretary) Aspin. See Tables 1 and 2 for a more detailed description of force changes.

not to store any assets for reconstitution purposes if they believe that their expanded force equipment requirements can be satisfied from new production within the strategic warning period postulated in the guidance. (Indeed, this has been the USAF's position on reconstitution.) The Navy and USAF do preserve and store excess aircraft. However, the primary intended uses of those assets are for foreign military sales, as a source of spare parts and components, and as drones.

**Table 1**

*Force Drawdown Comparisons*
*1989-1997*

| 1989 | 1994 (Base Force) | 1997 (Clinton Administration Proposal) |
|---|---|---|
| **Army Divisions** | | |
| 18 Active | 12 Active | 9 Active |
| 10 Reserve | 6 Reserve | 6 Reserve |
| 28 Total | 18 Total | 15 Total |
| **Tactical Fighter Wings** | | |
| 34 | 26 | 18 |
| **Aircraft Carriers** | | |
| 15 | 12 | 10 Active |
| | | 1 Reserve |
| | | 1 Overhaul |

The second option is to adopt a policy of requiring the Services to retain sufficient excess equipment (over and above authorizations for war reserve stocks) to enable a rapid (say, in 30 months) force expansion up to a specified level. The specified level could, for example, be a return to the previous Base Force levels. (In the case of the Army, this would represent 3 divisions, assuming that the starting point would be Mr. Aspin's Option C force.) Under this policy option, the Services would then need to address the many specific issues associated with implementation of the policy such as: criteria for which individual items to store; preservation options; storage sites; funding requirements; the development of plans for the management of the stored assets; and the harmonization with manpower and training issues related to the forces to be reconstituted from the stored equipment.

Adopting a storage policy should not imply an indefinitely long period of storage. Laid away equipment needs to be actively managed and periodically reviewed to ensure that only equipment that is still needed and useful is being retained. Our judgement is that 10 years is about the limit of time that most equipment will retain its military utility (ships are probably an exception).

The costs of equipment storage can be quite modest. We have estimated that storage of an armored division would incur costs of about $10M the first year,

and $5M per year thereafter. Aircraft storage costs vary depending upon the specifics of the storage strategy; storage costs for an F-15 wing (72 aircraft), for example, would range from about $1-3 million per year. Aircraft carriers incur inactivation costs of about $66M and 5-year maintenance costs of $1M. Costs for storing all of the production tooling for the B-1B bomber at Davis-Monthan AFB were about $1M, initial costs, plus $220,000 per year thereafter. (See photos at end of this paper.)

A decision regarding equipment storage policy is somewhat dependent on the depth of additional force reductions (i.e., below the Base Force). Generally, the deeper the cuts, the greater the risk and therefore the case for storage is stronger. If our rough cost estimates in this paper have captured the major cost elements, and if DoD is looking for a low cost insurance policy against the risks of cutting too deeply, then the storage option should be given serious consideration. It is the only choice available for allowing a relatively quick, limited buildup of forces.

Although the focus of this paper is on equipment, we also recognize that other ingredients are necessary in order to enable new forces to be created in minimum time using stored equipment. The principal factors other than equipment are manpower and training. For example, where will the aircrews and other manpower come from to operate the regenerated aircraft? How long will it take to train them? Will the training base be adequate to handle such a surge requirement? These (and others) are questions that any planning for a rapid force expansion using stored equipment would need to consider, in coordination with planning for the regeneration of the *equipment*.

***We recommend*** that the DoD decide, at the highest levels, whether our new military strategy needs to include, for the near-to-mid term, the capability for a limited, relatively quick force expansion based on the regeneration of stored equipment. It is essential that the decision be made now, before the equipment currently becoming excess is disposed of or committed to other purposes, or left to deteriorate in open storage. If the decision is made in favor of storage, then it will need to be appropriately reflected in programming priorities. Otherwise, given the current severe budgetary climate, the Services may be apt to treat the storage program as just one more requirement for which there are no funds.

Further, if a decision is made in favor of storage for force expansion purposes, then the Services will need to ensure the existence of appropriate management programs to include, at a minimum, the following elements:

- assignment of organizational responsibilities
- identification of options for storage and maintenance, and determination of associated funding implications
- appropriate manpower and training programs geared to the breakout and use of stored equipment.

With respect to the preservation and storage of the production line tooling for major end items of equipment, we have concluded that it should be done only on a case-by-case basis; that, in general, the likelihood is small that at some future time we will want to reopen an old production line. For those instances when lay away of production tooling is warranted, we have provided a number of recommendations based on the "smart" shutdown of the Pershing II line. (See the discussion below on "Production Lay Away" and in the appendix.)

In the remainder of this paper we discuss (1) the central role that assumptions about time plays in force expansion considerations, (2) the equipment available for storage, (3) the need to reconcile any equipment storage programs with the pressures to reduce inventories, (4) the pros and cons of production tooling lay away, and (5) costs of storage.

**Table 2**

***Active Army Divisional Force Structure Changes 1989-1997***

| 1989 | 1994 (Base Force) | 1997 (Aspin Option C proposal) |
|---|---|---|
| **Forward deployed Forces** | | |
| 1st Armored | 1st Armored | 1 HVY (Germany) |
| 2nd Infantry (MX) | 2nd Infantry (MX) | |
| 3rd Armored | | |
| 3rd Infantry (MX) | 3rd Infantry (MX) | |
| 8th Infantry (MX) | | |
| 25th Infantry (Light) | 25th Infantry | |
| **Contingency Forces** | | |
| 1st Cavalry | 1st Cavalry | 1st Cavalry |
| 6th Infantry (Light) | | |
| 7th Infantry (Light) | | |
| 10th Infantry (Light) | 10th Infantry (Light) | |
| 24th Infantry (MX) | 24th Infantry (MX) | 24th Infantry (MX) |
| 82nd Airborne | 82nd Airborne | 82nd Airborne |
| 101st Air Assault | 101st Air Assault | 101st Air Assault |
| **Early reinforcing Forces** | | |
| 1st Infantry (MX) | 1st Infantry (MX) | 1st Infantry (MX) |
| 2nd Armored | 2nd Armored | 2nd Armored |
| 4th Infantry (MX) | 4th Infantry (MX) | 4th Infantry (MX) |
| 5th Infantry (MX) | | +1 other HVY |
| 9th Infantry (Motorized) | | |

# THINKING ABOUT TIME

Two independent assumptions about time are critical in determining whether equipment should be stored for force expansion purposes. First, when is the earliest point (how many years from now) we believe we may have to use the stored equipment? Second, once a force expansion decision is made, how long do we believe we would have to complete the desired buildup? If it is assumed that no force buildup would be necessary in the near-to-mid term (within the next 10 years), then it becomes harder to justify laying away large quantities of today's excess equipment. Further, if the time available to achieve the buildup is relatively long (3-5 years or more), new production of more capable equipment becomes possible. On the other hand, to the extent that both of the foregoing (benign) assumptions about time are not warranted, the case for lay away becomes more attractive. In our judgment, the *only* way that a limited buildup (back up to, say, the level of the Base Force) could be achieved in less than 3 years is by using equipment already in existence. (An exception might be possible for some items still in production, wherein the increased demand could be satisfied via new production.) Although storing equipment will reduce the time required to form new units, some minimum time, perhaps as long as two years or more[3], would be required – due to manpower and training considerations – to produce new *combat ready units* no matter how much and how soon the equipment were available.

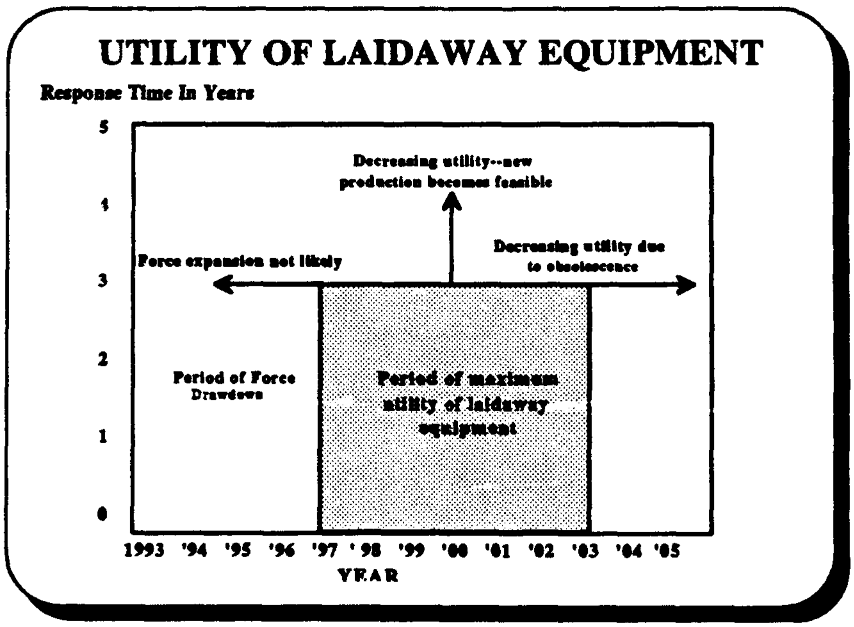



**Figure 2**
*UTILITY OF LAID AWAY EQUIPMENT*

[3] Depending on a number of variables, including whether the new units were being formed "from scratch", or were already in existence in some "cadre" form.

Figure 2 shows the conceptual interrelationship of these two time-related assumptions. The period of utility is shown in relation to when we would expect to use stored equipment, in relation to today (1993), as well as in relation to how long we believe we would have to achieve the buildup. During the period 1993 through 1997, we believe the need for the creation of new force structure to be unlikely. The drawdown will be continuing during most of that period, and the easiest way to achieve force levels above the planned objective, (such as Option C, is simply to cancel programmed inactivations before they occur. On the other hand, beyond 2003 or so, the utility of stored equipment will steadily decrease as the age, obsolescence, and manning factors become more critical. While the need to rebuild forces will still remain after that time, in general, stored equipment will have less value for that purpose. Investment in maintaining a viable defense oriented production capacity, as well as a robust research program, will yield more long term benefits than continued investment in stored equipment for force expansion purposes. Thus, the approximate period between 1997 and 2003 is seen as the period when laid away equipment would have its greatest, although not its only, utility.

When a decision is made to store a particular set of equipment for force expansion, that should not imply an indefinitely long period of storage. Laid away equipment needs to be actively managed, and periodically (routinely) reviewed, to insure that only equipment that is still needed and useful is being retained. The continued military utility varies greatly by type of equipment, age, where it resides on the technology spectrum, and on the relative capabilities of a particular threat. Our judgment is that, in general, ten years is about the limit of time that most equipment will retain its military utility; some items, particularly electronics, will become obsolete in less time, while others, such as ships, may have utility well beyond ten years. The rate at which the utility of stored equipment declines must be judged on an item by item basis.

# EQUIPMENT

## Major End Items

The drawdown is producing — and will continue to produce for some time — large quantities of equipment requiring disposition. For example, a reduction of 10 tactical fighter wings would produce an excess of approximately 800 aircraft; armored divisions each contain more than 300 tanks and thousands of other vehicles. We are not suggesting, however, that all of this excess equipment should be retained for possible force expansion. The reason is that the equipment currently becoming excess covers a wide spectrum; from obsolete equipment, (e.g., Vulcan air defense gun, F-4 fighters), obsolete equipment which may still have residual useful life but which has been superseded by more modern equipment (e.g., 2 1/2 ton trucks, M60A3 tanks, FF1052 Class frigates), to equipment that is still being used by front line forces (e.g., M1 tanks, F-15 fighters).

Figure 3 depicts notionally the mix of major end items of equipment starting with the FY 89 force, active and reserve, showing the relative proportions of old, obsolete equipment still present in fielded units; a larger proportion of equipment which could be categorized as newer, more serviceable equipment, but not the latest, most modern item; and lastly, the proportion of equipment representing the most modern currently available. The figure shows the opportunity for changing the mix as the force levels decline. In getting down to the Base Force level, the proportion of modern equipment available for force expansion is smaller than that at lower force levels (i.e., Option C). Rebuilding modern forces from the Base Force level back up to the FY89 force levels with laid away equipment would be difficult, given that other claimants exist for the best equipment within the remaining structure. However, at the Option C force level, the amounts of modern equipment becoming excess may support a limited buildup, perhaps to the Base Force level as we have previously discussed.

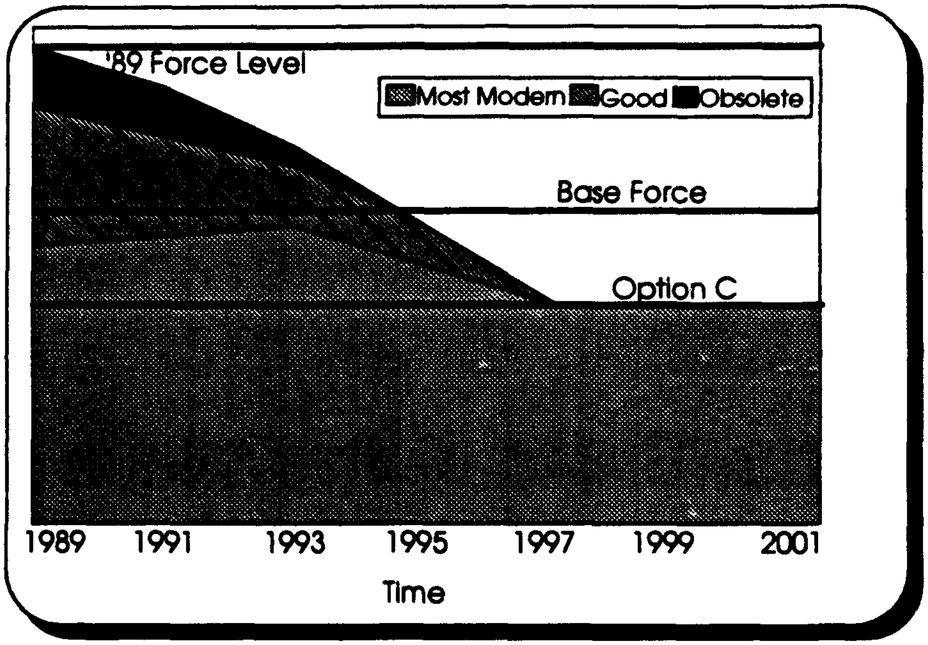



**Figure 3.**
***EQUIPMENT MIX VERSUS FORCE LEVELS***

It is important to understand that some equipment currently is being stored which, although not labeled as reconstitution assets, would be available if needed to support a buildup. This includes mothballed Navy ships and Air Force and Navy tactical aircraft. Although the large numbers of A-7s and F-4s currently in storage are older, and mostly obsolete, the inventory inevitably will become more modern as the total force is downsized. The Air Force position with respect to these aircraft is that their principal use will be for foreign military sales. The

Navy's mothballed ships, although designated as "mobilization assets," would also be available as force expansion or reconstitution assets.

## Actual Equipment Mix (USAF Fighters)

Figure 4 shows the change in Air Force fighter aircraft from September 30, 1990, through December 31, 1992. Note that the overall trend in this limited snapshot is down, and the mix between modern and obsolete occurs just as we showed in our notional depiction.[4] What is not shown is the impact of further reductions to the Base Force or below; our point is that those projected reductions will begin to generate excesses, certainly of good equipment, and possibly of some of the most modern equipment.

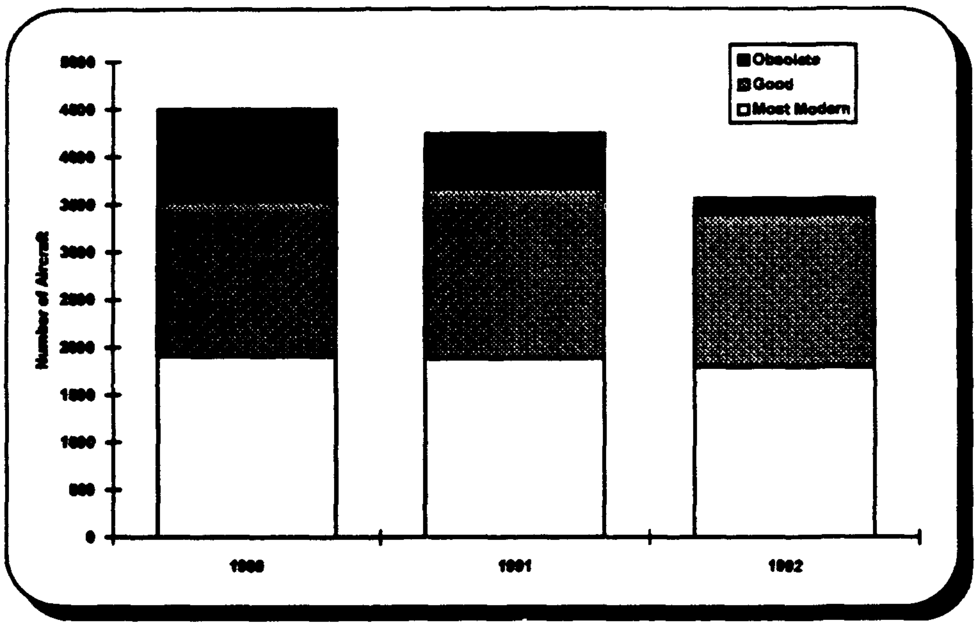



**Figure 4**
***AIR FORCE FIGHTER MIX***

## Equipment Other Than Major End Items

In those instances where the displaced equipment does match the equipment fielded in the remaining forces, a good case can be made for temporarily retaining some or even most of it. Having said that, it is important to understand that major end items alone will not be sufficient for a force buildup.

[4]We defined aircraft shown in Figure 4 as follows: obsolete: A-7, A-37, F-4 (except G model); good: A-10, F-111, early models of F-15 and F-16, F-4G; most modern: latest models of F-15 and F-16, F-117.

As shown in Table 3, a typical armored division has more than 1300 different lines (types) of equipment, with more than 180,000 individual items. The cost for new acquisition of an armored division's equipment approaches $3.5 billion. The division data in this display are categorized by commodity command. For comparison with both the division totals and the various categories, the relevant data for an M1 tank is separately shown. Note that the tank, the single most important item in an armored division, comprises less than 1 percent of either the types of equipment or the number of items, but accounts for almost one quarter of the dollar value. The point is that gathering all the equipment necessary for a division is an expensive, time consuming, and complicated process. Therefore, specific policy decisions and management initiatives are necessary to ensure the harmonization of this process. While not all end items for a division need be stored, if a policy decision is made which supports storage for force expansion purposes, plans should identify when each item may become available (six months, two years, etc.) and from what source (war reserves, other storage, new procurement).

Table 3 allows many interesting comparisons. Communications and Electronics Command manage more than one fourth the total items, but they comprise only 12 percent of the dollar value of a complete division. On the other hand, Tank and Automotive Command manage almost 60 percent of the dollars but less than 4 percent of the items. Many other activities are involved in managing smaller, yet essential slices of a division's requirements. Without some management structure overseeing all the activities, we think that acquiring the equipment to rebuild a division in a coordinated, timely process, whether from new production, storage, or a combination of the two, is highly unlikely.

**Table 3**

***Typical Armored Division***
***(Selected data by commodity manager)***

| Commodity commands | # of LIN'S | % | # of Items | % | Required $000s | % |
|---|---|---|---|---|---|---|
| Armament/Munitions | 190 | 14% | 64,293 | 35% | 134,780 | 4% |
| Comm/Electronic | 488 | 36% | 51,277 | 28% | 418,822 | 12% |
| Troop Support | 140 | 10% | 32,397 | 18% | 24,045 | 1% |
| Comm Security Agency | 61 | 5% | 16,486 | 9% | 31,105 | 1% |
| Army Petroleum Center | 163 | 12% | 7,291 | 4% | 2,072 | <1% |
| Tank/Automotive | 124 | 9% | 6,889 | 4% | 2,050,960 | 59% |
| Missiles | 49 | 4% | 1,809 | 1% | 52,834 | 2% |
| Aviation Systems | 65 | 5% | 919 | 1% | 619,267 | 18% |
| Medical Material Agency | 48 | 4% | 555 | <1% | 1,653 | <1% |
| Miscellaneous | 21 | 2% | 202 | <1% | 137,153 | 4% |
| **Total** | 1,349 | | 182,212 | | 3,472,691 | |
| Selected item<br>M1 120mm tank | 1 | <1% | 317 | <1% | 802,343 | 23% |

## Disposal Versus Storage of Excess Equipment

While excess equipment makes limited force expansion possible, there is at the same time very strong pressure to dispose of the equipment to reduce inventory costs. Indeed, major defense management initiatives to reduce the cost of "excess inventory" are currently underway (DMRD 901/987). During the period FY1990-1992, more than 55,000 tactical wheeled vehicles were retired from the Army, and an additional 90,000 vehicles are projected to be available for retirement between FY 1993-1995. These numbers are large, but pale in comparison with the totality of all equipment, their repair parts, and the support equipment needed to activate new units. These projected retirements were based on the reductions to reach the Base Force. Any further reductions below those levels will increase the equipment disposal problem accordingly. Numbers of smaller but yet significant magnitude can be found for all types of equipment, in the other Services as well. The large quantities of equipment involved dictate that the process of inactivating, categorizing, and determining the best disposition will continue for several years, until the force drawdown stabilizes. Since there is significant pressure to dispose of equipment to reduce storage, handling, and transportation costs and to alleviate space constraints, any efforts to retain substantial amounts of equipment for force expansion purposes during this period will require a change in the way we define "excess." If we intend to use stored equipment to rebuild forces, we will need recognition of and authorization for DoD components to retain equipment for force expansion (i.e., in addition to war reserves) in the applicable DoD policy directives.

The Defense Logistics Agency is currently reviewing 62 government owned and leased storage facilities to determine the opportunity for reductions of on hand inventories and facilities. A goal has been established to reduce gross storage space by 30% over the next few years. As shown in Table 4, as of December 30, 1992, the aggregate vacancy rate, across all DLA CONUS facilities, is only 12% for covered storage. Since that 12% is distributed over many activities, in practical terms, most are at or near saturation. The picture looks better for open storage in aggregate but most of the available space exists at just a few installations. Most are saturated. It is this saturation, in part, which is driving the current inventory reduction program, but base closures and depot consolidations will reduce available space at the same time. If storage for reconstitution is a policy objective, now is the time to establish the storage requirements.

It is useful to point out that storage of excess equipment, which may have utility in the future as the basis for new force structure, does not have to occur at DLA facilities. Equipment storage sites could be established at operational installations where real estate is available. The storage and maintenance responsibilities could be retained within the Army structure, either by the command operating the installation, or as a field activity of the Army Materiel Command. Storage and maintenance responsibilities would remain within the Army rather than being transferred to the Defense Logistics Agency. This policy,

**Table 4**

***DLA Storage Summary (m sq. ft.) CONUS (as of December 1992)***

| | TOTAL COVERED STORAGE | TOTAL OPEN STORAGE | TOTAL STORAGE SPACE |
|---|---|---|---|
| | ALL | IMPROVED/ UNIMPROVED | |
| Total available | 101 | 54/25 | 180 |
| Net sq. ft. | 52 | 34/19 | 105 |
| Occupied sq. ft. | 46 | 22/9 | 77 |
| % vacant | 12% | 35%/51% | 27% |

while not necessarily any cheaper than storing at a DLA facility, would overcome the space constraints currently being felt at many depots.

It is necessary to reconcile the DMRD's direction focusing on inventory reduction with the requirement that some materiel be retained. The key will be an aggressive program to dispose of the large quantities of equipment with limited or no military utility, while keeping the newer, more modern equipment that does have military utility. The quantities of specific commodities either being disposed of or being retained, combined with the storage space required and potentially available, will determine the net change in storage facilities required as well as the facility costs associated with the new program. The Services should define appropriate categories within the excess to recognize the potential claim for reconstitution assets. This can be accomplished and remain consistent with the need to reduce inventories if the focus for disposal is limited to the large amounts of obsolete, or older equipment (e.g., there are almost 4,000 obsolete tanks sitting in storage facilities solely because the money to demilitarize them has not been available). The ultimate disposition of all equipment excess to the requirements of a particular force structure will be decided by the priorities given to the various claimants, by our evolving national defense strategy, and world events. The principal claimants include: existing force structure and war reserve accounts, including prepositioning programs; force expansion requirements (if any); and foreign military sales. Equipment for which we have no further need but which may be put to effective use for peacekeeping or other humanitarian uses (such as four wheel drive commercial type vehicles) also should be identified.

## Production Lay Away

Just as force levels will decrease sharply over the next several years, so will the production of weapon systems and other military equipment. Accordingly, a parallel concern in planning for force expansion is whether to lay away industrial plant equipment. Our study of the Pershing II missile system provides an example of how – when lay away is desirable and justifiable – industry can use "smart" shutdown procedures such as the storage of

unique production equipment and components, and archiving technical data to provide force expansion capabilities. (See Appendix for a detailed description of the Pershing II production lay away process and related findings and specific recommendations regarding production lay away.) However, for the more technically advanced weapon systems, (e.g., missile systems) the usefulness of such capabilities may decrease relatively quickly. As an example, for electronic components, the useful life of laid away components and the associated production equipment may be five years or less because of the rapidly changing technology. Thus, the changing technological environment requires a periodic review and redetermination of the value of laid away production facilities.

In any case, before addressing the details of how to do lay away, the more basic question needs to be asked; "What is the likelihood that we would - at some indeterminate point in the future -- want to reopen new production of a rapidly obsolescing system"? We believe the answer is "small," especially for a limited (nonglobal threat) buildup, and even "smaller" if we have laid away the amounts of end items of equipment that would allow us to rebuild to (or close to) the Base Force. In the case of a re-emerging global threat, with an assumed longer strategic warning time, and presumably a more sophisticated threat, we would be even less inclined to reopen production of an old system. Thus, any decision to lay away industrial production equipment peculiar to a particular weapon system must be carefully justified.

A further question remains as to the value of laying away more generic industrial plant equipment, either contractor or government owned, which is not peculiar to a specific weapon system. Based on our study of the Pershing II, it appears that the more generic equipment is more likely to be owned by the contractor. Upon production termination, such equipment will be used on other production lines or disposed of as excess. In the case of the Pershing II system, approximately 25 percent of the production equipment (Pershing – peculiar items) were laid away. In order to restart production, diversion of contractor-owned production equipment being used on other lines would be necessary. Whether contractor or government owned, such generic equipment is likely to have a longer useful life than system-peculiar equipment. On the other hand, evolutionary improvements in production technology processes will tend to shorten that period. Accordingly, government-sponsored retention of any such equipment should be made on a case-by-case basis rather than as a matter of policy.

Any recommendations to lay away production equipment should be made by program managers, in coordination with Service requirements and operations planners (e.g., for the Army, DCSOPS), to the Service Acquisition Executive prior to completing production of the systems. Factors to consider would include the likelihood of needing additional production of the same item within the next several years, the uniqueness of the production process equipment, and the criticality of subtier vendors. At such time, program managers should be prepared to recommend the quantity and types of equipment to be stored, expected storage duration, and estimated costs. Management responsibility for the stored assets, including decisions concerning possible reuse for other projects, could be assumed

by the appropriate commodity commands. For the PII, it would be the U.S. Army Missile Command. To assist in this regard, "system deactivation offices" could be established at Service system acquisition commands and the Defense Logistics Agency. These offices could supplement the terminated project management offices in the following capacities: as managers of the stored production equipment; as a repository of production termination and lay away expertise to advise other program managers regarding production lay away; by assisting in possible system reconstitution planning; by retaining core pr management capabilities for possible force expansion; and by coordinating component or production equipment reuse programs.

The Federal Acquisition Regulation (Section 52.245-17) provides procedures for disposition of GFE special tooling upon termination of production contracts. However, criteria upon which to base those decisions are not contained in that directive. Accordingly, additional guidance is required in determining the appropriate disposition of such equipment.

A linked issue is the erosion of the workforce skill base. In some cases, the inventory of skilled workers may decline as a result of layoffs, retirements, etc., more rapidly than would the useful life of the stored equipment. We are not aware of any mechanism in industry for tracking or recalling critically skilled former employees.

## Stored Equipment Versus New Production

This discussion of force expansion via the use of stored equipment would not be complete without directly comparing the merits of storage with new production, including both the new production of existing designs and new production of new designs. Table 5 provides a summary of the major advantages and disadvantages of each.

We make the assumption that laid away major end items of equipment can be put back into service more quickly than new production can produce similar quantities of equipment, except possibly in those cases where an item is still in production. Even when there is a warm production line for a particular item it is not clear (and indeed may be unknowable, given the great uncertainties associated with such a future, hypothetical event) whether the demand could be met by new production in time. We recall from past JCS mobilization exercises the time required to surge warm production lines of tanks and aircraft was quite long – typically one to three years to just double (then) current production rates.

Table 5

*Storage Versus Production Summary*

| | STORAGE | NEW PRODUCTION OF EXISTING DESIGNS | NEW PRODUCTION OF NEW DESIGNS |
|---|---|---|---|
| PRO | •Relatively inexpensive<br>•Relatively quick<br>•Equipment available | •No RDT&E required<br>•Quicker and cheaper than new-new production<br>•Minimal investment other than lay away of production tools | •Most modern/capable<br>•Little or no investment now other than continuation of planned R&D programs |
| CON | •Requires funding throughout storage period<br>•Requires active management of stockpiles<br>•Insurance policy that may never be needed<br>•Obsolescence a potential problem | •No growth in military capability<br>•Slower than breakout of stored equipment<br>•Obsolescence a potential problem | •Requires on-going R&D<br>•Longest lead time |

It is tempting to compare the costs of storage to the costs of new production. However, the costs of storage are real costs, to be incurred over the period of storage, while the costs of surge production are potential costs, and will be incurred only in the event of a reconstitution. Thus, we believe the costs should not be directly compared. Further, and most important, these alternatives are not mutually exclusive, either as planning alternatives or in execution. In the event of an actual force buildup, one can easily imagine a scenario in which, initially, a limited buildup is required and laid away equipment is used to form new units; then, conditions may further warrant surging warm production lines and reopening of selected laid away production lines; eventually, world conditions deteriorate to the extent that buildup is necessary to meet a global threat and the industrial base is mobilized to produce new, advanced equipment. Thus storage should be seen as an insurance policy, with real costs to be incurred in the 1990s, and the relevant question regarding cost is: "How much force expansion capability can be had at what cost?" In the next section we make some rough estimates of the cost of a storage program.

# COSTS

Determining the costs associated with storing equipment specifically for force expansion purposes is a complicated process. Some of the costs, for some major end items particularly, are going to be incurred regardless of whether force expansion has been established as a purpose for storing the equipment. For

example, the Air Force and Navy preserve and store excess aircraft for a variety of purposes; and the Navy will continue to mothball ships. On the other hand, there are other costs that may or may not be incurred, depending on the details of how equipment is to be preserved, where it is stored, how it is stored, whether and how it is to be maintained, etc. We were not able to make such incremental, or net cost, estimates within the scope of this study. We have, however, made rough estimates of what the storage and maintenance costs would be, under several different sets of assumptions.

DoDD 4145.19 "Storage and Warehousing Facilities and Services," dated August 13, 1975, establishes principles of charging for storage and warehousing. We used some of the 1993 rates in our estimates. However, there are many cost elements that differ by class of supply, preservation levels, maintenance policies, etc. Further, the establishment of the DoD Defense Business Operations Fund (DBOF) created another set of processing rates that DBOF storage facilities may charge DoD customers for DBOF material. Further complicating hypothetical cost calculations is the fact that ordinarily one DoD component does not charge other DoD activities for storage services "unless the requirements involve significant or unbudgeted costs." In that instance, charges may be negotiated to cover actual or estimated costs when the DoDD rates are considered inequitable. Given that uncertainty, with the data available it is still possible to estimate a range of storage costs for specific *items* of equipment, for specific installations. It is far more difficult to aggregate the costs for different type *units*.

Another variable is the desired level of preservation and the equipment condition (or "condition code") to be maintained for stored equipment. Level "A" is the standard preservation level in the Army for equipment placed in long term storage, if the item is intended to be available for issue as a serviceable end item. At this level, all sub-assemblies and components are operable and the equipment requires no work prior to issue. Also, modifications that have been fielded for a particular end item since being placed in storage *may* have to be applied to maintain compatibility with the actively fielded end items. However, a low cost option is not performing any repairs or modifications prior to preservation and storage. Thus, the equipment would be stored "as-is," and repairs and modifications would not be made unless — and until — the equipment needed to be brought out of storage. This is the Navy's practice with the respect to the mothballing of its ships. Thus, the costs can vary widely according to the storage philosophy selected.

Having said that, we show what we believe to be reasonable estimates for storing two type units (using data available from the Services and the Defense Logistics Agency); an armored division and an Air Force tactical fighter wing. We also show the cost for Navy ship inactivation and storage, on a per ship basis.

## Armored Division

The costs to store an armored division can vary widely, depending on the conditions of storage and the method for determining costs. The only historical

storage cost data presently available for an armored division are the costs associated with POMCUS units.[5] These costs represent the highest cost option possible; the equipment was maintained in humidity-controlled warehouses in Europe in a high state of readiness. We do not believe these costs are appropriate for comparison with other options identified in this paper. The high readiness is not required for the type of force expansion described herein. Rather, we have used three other costing approaches and applied them to a division set of equipment to establish more reasonable storage cost estimates. The first costing method used requires a one-time charge for transferring items between the Services and DLA, calculated on a *per item* basis; the second method uses the DoDD 4145.19 government storage rates, on a square foot basis; and the third method uses commercial storage rates, on a square foot basis.

The storage and maintenance cost for an armored division set of equipment are summarized below. A more detailed discussion of the various costing elements and methodology follows the summary.

## Cost Summary

As shown in Table 6, the range of possible costs to store and maintain the equipment for a laid away division is wide. The high, medium, and low estimates were derived from data provided to us and are discussed in the succeeding paragraphs below. For force expansion purposes, we believe the conditions and assumptions behind the high and low estimates are not applicable. We used the medium cost calculations as a point of departure, and then assumed that less stringent annual inspection and maintenance requirements were acceptable for equipment stored for force expansion purposes, particularly if placed in a favorable storage environment such as the southwestern United States. Given those assumptions, our estimates are that it would cost approximately $10M per division equivalent the first year and $5M per year thereafter. (Our estimates of the nonrecurring, first -year costs are in line with estimates provided to the Army by the Aerospace Maintenance and Regeneration Center at Davis-Monthan AFB, Tucson, AZ.)

**Table 6**

***Armored Division Cost Summary ($M)***

| | Alternatives | Storage costs | Maintenance costs | | Total Costs 1st Year | Recurring Annual Costs |
|---|---|---|---|---|---|---|
| | | | 1st Year | Recurring Yrs. | | |
| Estimates based on data provided to us | High | 15 | 22 | 11 | 37 | 26 |
| | Medium | 2 | 7.6 | 6.1 | 10 | 8 |
| | Low | 1 | 3 | 0 | 4 | 1 |
| LMI Estimate | | 2 | 8 | 3 | 10 | 5 |

[5] POMCUS is equipment stored in unit sets, which rapidly deploying U.S. units were to fall-in on, in a NATO-Warsaw Pact scenario.

These costs do not include the cost to move the equipment from their deployed locations to the storage and maintenance sites. Further, given that the above costs appear manageable, it must be remembered that the potentially largest costs to store equipment for force expansion would be incurred by bringing the equipment to be stored up to Condition Code "A" or "B" prior to storage, although these costs may be deferred until the time of regeneration if the equipment is stored "as-is." Thus we have not included any such costs in our estimates.

In addition to the costs described above, the costs for the non-divisional support elements also need to be recognized. Retaining the capability to create new combat units with stored equipment will have limited value if a corresponding capability to create new support units is not also retained. The size of the support element required for a specific mission depends on many variables that are not known in advance; however, the support package to be stored might be sized using the Army's force packaging methodology that was used to determine the generic support required for the afloat prepositioning program.

## Storage Cost Discussion

DLA Transfer Rates — the DBOF rates do not apply to end items. Instead, a historical average, by Service, is being used to calculate the charges for items being placed into DLA storage facilities. The current rate of $38.44 per item would generate a one-time cost of $7M to store an armored division, assuming that all 182,100 items in an armored division are placed into storage for force expansion purposes. This rate is currently being reviewed by DLA, and will most likely be changed to reflect the actual costs incurred per item of equipment more accurately.

DoDD 4145.19 Government Storage — The DoD 1993 rates for DoD facilities are $2.48 per gross[6] square feet of controlled humidity warehouse required, and $.41 per gross square feet of open storage required. Assuming 2.5M square feet of space would be required for the 1.5M square feet of equipment in an armored division (i.e., some space has to be allowed for movement within the warehouse), calculating storage costs on a square foot basis yields a range between $6.2M if in humidity controlled warehouses and $1M if in open storage. Most likely, much of the equipment could be stored outside if properly preserved and in a dry, noncorrosive climate. Thus the cost would probably be somewhere between $1M and $6M for storage using this methodology.

Commercial Storage — A recent Army study of commercial storage costs in CONUS determined that controlled humidity warehouses could be purchased for $62 per gross square foot or leased for $6 per gross square foot. Using those factors, the 2.5M gross square foot requirement would cost between $155M (non-recurring, new purchased facilities) to $15M per year (leased costs, recurring annually). These costs would be incurred only if government space were not available, and controlled humidity warehouses were required. Open storage is

[6]"Gross" square foot includes an allowance for some amount of open space between stored items to allow access and movement.

available at $.50 per square foot, yielding a cost of $1.25M if all were in open storage. The range for commercial storage is thus $1.25M – $15M per year.

Storage Cost Summary — We believe a reasonable mix for an armored division's equipment is 80 percent open storage and 20 percent humidity controlled warehouse. This is based on the assumption that wheeled and tracked vehicles could be stored outside, and they account for 80 percent of the total area represented by a division set of equipment. On this basis, and assuming government space is available, the storage costs incurred for the equipment of an armored division would be just over $2M per year. The cost could be lower if the equipment could be stored in space available at Army installations. If leased space is required, the cost to store the division would be approximately $4M. If the equipment is stored in DLA facilities, and no storage costs are charged, the one - time transfer charge would be $7M at current rates. While it is commonly understood that DoD activities do not charge other DoD activities for storage, we believe that there likely would be some charge, given the magnitude of the storage problem. The ranges of estimates are shown in Table 5.

## Maintenance Cost Discussion

In addition to the storage cost estimates shown above, the costs to maintain equipment in storage must also be included. The DLA transfer rate of $38.44 includes periodic inspection and maintenance costs, but the variations in preservation levels are not shown. We used Army cost estimates for the items of equipment shown below. These cost estimates include the processing (including preservation) charges and recurring storage and maintenance charges under different assumptions and conditions. These estimates were then aggregated to yield the cost for an entire division set of equipment.

Bradley Fighting Vehicle — An Army Materiel Command study of options for storing Bradley Fighting Vehicles established a range of $3,376 to $11,673 first year and $1,283 to $4,326 annual recurring costs per vehicle, depending on the storage method used. Red River Depot estimated the costs for processing and storing Bradley's as $2,815 first year and $2,345 recurring costs per vehicle if maintained in Condition Code A or B, and $556 first year cost and no recurring costs if maintained at Condition Code F. Thus we see the tradeoffs between incurring higher initial costs for lower recurring costs, and the cost differences driven by different equipment conditions. In this case, the initial costs for all light tracked vehicles in a division (1167) would range between $.648M and $13.6M. Using the Red River estimates, the total first year cost for all light tracked equipment would be $3.3 M. The recurring costs would range between $0M and $5M; the Red River estimate is $2.7M. Our best estimate of the minimum recurring cost for this equipment would be approximately $1.1M, assuming modified Level A preservation and packing, reduced COSIS, and a Southwest United States semi-arid environment.

M1A1 Tank — Data from Defense Depot Anniston give storage cost ranges for the M1A1 from $708 to $5330 (first year) and $0 to $3446 (recurring),

depending on whether the vehicle is maintained at Condition Code "A" or "F,"[7] and if "A," whether stored inside or outside. The division contains 1002 heavy tracked vehicles; assuming the storage costs for all are similar to the costs described for the M1, the cost range for serviceable equipment would be between $2.9M and $5.3M for the first year and $1.6M and $3.5M for annual recurring costs. We assumed outside storage with modified Level A preservation and packing in a Southwest United States semi-arid environment could reduce COSIS man-hours. Under those conditions, the annual recurring costs could be reduced to just over $1M.

HMMWV - Red River Depot estimates first year costs for processing and storing HMMWV's as $1600, assuming modified level A preservation and packing, with recurring COSIS costs at $946. On the other hand, Sacramento Depot estimated first year costs at $667, and recurring costs at $599. We used these figures as reasonable estimates for all the light tactical vehicles in the division. Using the lower figure, first year costs for approximately 2000 light tactical vehicles are $1.3M and recurring costs are $1.2M.

Other Tactical Vehicles — There are 1200 additional vehicles in a division which we would classify as heavy. We did not have maintenance data for these, but estimated the costs to be similar to the light vehicles because the processing steps are similar. We used Red River depot's higher figures and estimated first year costs at $1.9M and recurring costs as $1.1M.

Army Aircraft — Corpus Christi Depot estimates $882 first year costs and $555 recurring COSIS costs for Army aircraft. Assuming 120 aircraft in a division, the aircraft maintenance costs are approximately $100,000 for the first year and $65,000 per year thereafter.

Other Equipment — We have accounted for approximately 1.3M square feet of the 1.5m square feet of equipment contained in a typical armored division. The cost to maintain the remaining 200,000 square feet of material is assumed to be negligible. The storage costs for this material have been accounted for in the storage calculations.

## Tactical Fighter Wing

We relied upon data provided by the Aerospace Maintenance and Regeneration Center (AMARC). The data provided to us included a comprehensive examination of several options available for the storage and preservation of aircraft. We include three options – high, medium, and low cost. The high cost option includes process – in costs, two-year maintain-in costs, cost of installing safety modifications, flyout costs to return aircraft to flying status and rotate to units in the field. This cycle is repeated four times over an eight year period. The medium cost option is the same as the high cost except the aircraft are resealed instead of returned to the field every two years, and reconstituted for

[7]Condition code "A" connotes "Ready for Issue," while condition code "F" connotes unserviceable, but repairable equipment.

return to the field only at the end of the eight years. The low option is the storage cost only, with no return to the field during the eight years. Where the initial process-in costs are higher than the 8 year average, they are also displayed.

As shown in Table 7, the annualized costs for aircraft storage range from $13,000 to $44,000 for F-15 and $11,000 to $35,000 for F-16 aircraft; the cost for one wing (assuming 72 aircraft per wing) ranges from $.8M to $3.2M, depending on the storage option and type aircraft (see Table 8). The first year costs are higher for both the medium and low cost option. Just as we saw with armored divisions, the combatant vehicle represents only part of the costs associated with rebuilding entire units. Tactical fighter wings do not contain the wide range of equipment found in army divisions, but do have additional essential equipment that may require storage along with the aircraft if the intent is to rebuild units. Judgments would need to be made regarding those additional storage requirements. The storage costs to retain sufficient aircraft to rebuild tactical fighter wings thus appear to be reasonable, even under the high cost option.

**Table 7.**

***Aircraft Annual Storage Costs -- Per Aircraft***
***($ annualized based on 8-year program)***

| | F-15 | F-16 |
|---|---|---|
| High Cost Option | $44,000 | $35,000 |
| Medium Cost Option | $23,000 ($30,000 1st year) | $20,000 ($26,000 1st year) |
| Low Cost Option | $13,000 ($30,000 1st year) | $11,000 ($26,000 1st year) |

We recognize that some of these costs are already being incurred under existing policy, although not in the name of force expansion or reconstitution. Excess Air Force aircraft are currently processed into AMARC and held in one of several categories of storage, one of which (long-term storage) is similar to the low cost option discussed above. Therefore, some portion of the costs associated with the 3 above options most likely would be incurred in any case.

**Table 8.**

***Aircraft Annual Storage Costs -- Per Wing***
***($ annualized based on 8-year program)***

| | F-15 | F-16 |
|---|---|---|
| High Cost Option | $3.2M | $2.5M |
| Medium Cost Option | $1.7M ($2.2 1st year) | $1.5M ($1.8M 1st year) |
| Low Cost Option | $.936M ($2.2M 1st year) | $.792M ($1.8M 1st year) |

## Cost Sensitivity to Specifics of Storage Program – Examples

In order to illustrate how the costs of an aircraft storage policy can vary depending upon the particulars of the program, consider the following storage option. Periodically (e.g., every 2 years), a specified fraction of the stored fleet could be brought out of storage, outfitted with all appropriate modifications and reintroduced into the force structure. Concurrently, an equal number of items would be taken our of the force structure and placed in storage. The advantages of this concept are that (1) it would effectively extend the life of the fleet, and (2) it would help maintain the depot-level industrial capabilities. However, the somewhat higher costs associated with such a program would be a key consideration. The major cost element probably would be the acquisition and installation of modification kits to match current fleet configurations.

Another interesting example of how storage costs would be affected by the specifics of how the policy is implemented by the Services pertains to the management of spare high value repairable components. Rather than storing spare components, an alternative would be to keep them actively in use in the supply system (i.e., over and above authorized stockage levels for peacetime operating stocks and war reserves). This would mean that those items would need to receive update modifications along with the rest of the inventories of such items. That, in turn, would increase the costs of modification programs. On the other hand, it would enhance the capability of the reconstituted forces, and ensure their compatibility with the rest of the force structure.

## Navy Ships

The Navy has had a long-term ship inactivation and storage program. Therefore, if DoD were to adopt an equipment storage policy, there should be no additional costs associated with ship lay away; that is, over and above the costs that will be incurred in any case.

Navy ships are typically laid up with the ship's compartments sealed and dehumidified. Some machinery and certain weapon systems are placed in a preserved condition. Activation costs vary widely, depending mostly on the material condition of the ship at time it was laid away. It has been standard Navy practice to prepare a Ship Alteration and Repair Package (SARP) for ships (except carriers) at the time of inactivation. The SARP documents the outstanding repairs and alterations applicable to the ship together with man-hour estimates for completion of the individual elements contained in the SARP.

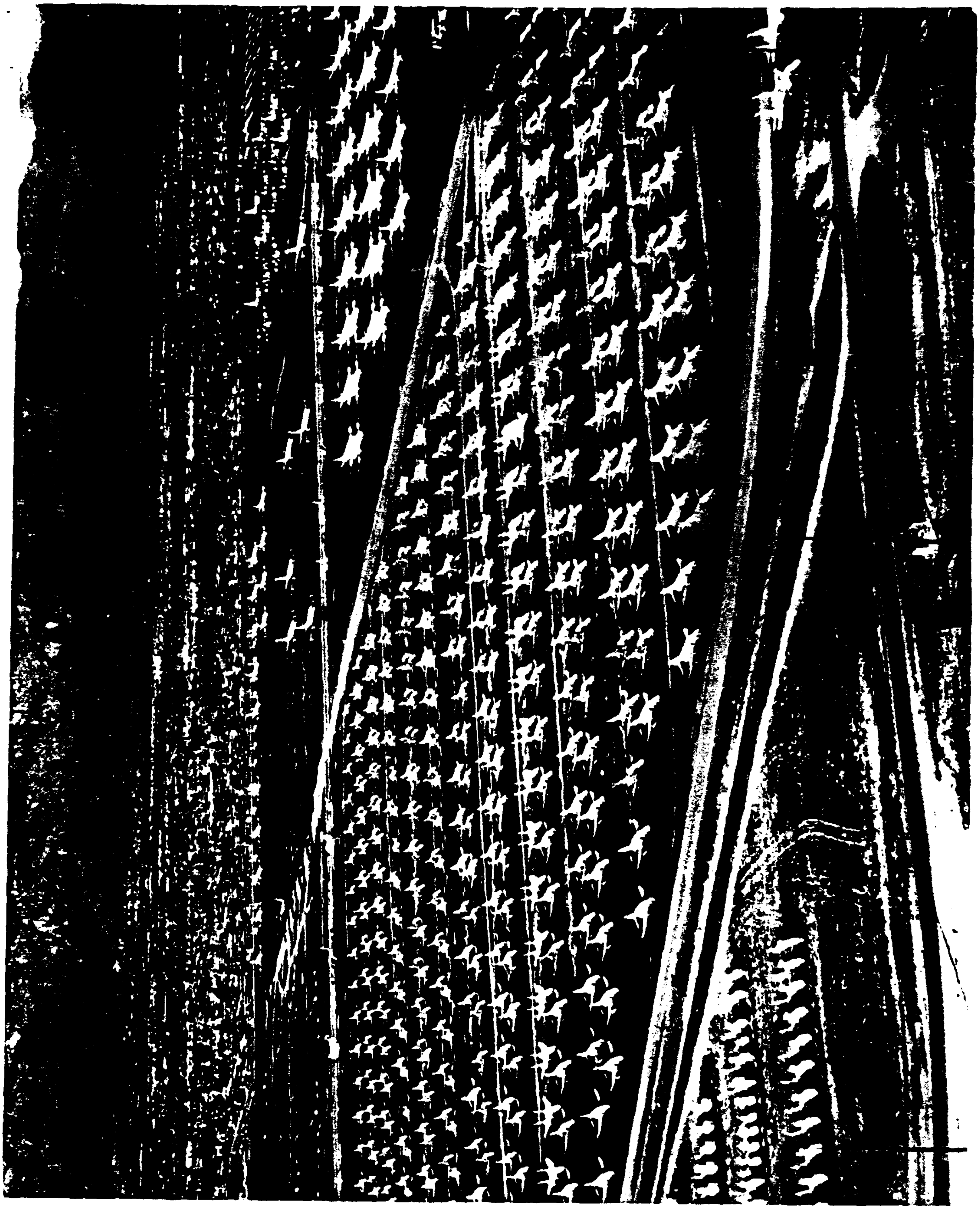
Table 9 reflects average historical inactivation and storage maintenance costs for an aircraft carrier and surface combatants found in a typical carrier battle group (CVBG) and for amphibious warfare ships required to constitute an Amphibious ready Group (ARG). Because CVBGs and ARGs can take on a variety of configurations, the cost per group can be derived once the composition is set. Because maintenance costs of "mothballed" ships vary from year-to year, annualized (five-year average) costs are provided.

**Table 9.**

***Navy Ship Inactivation and Maintenance in Storage Costs (FY93 dollars)***

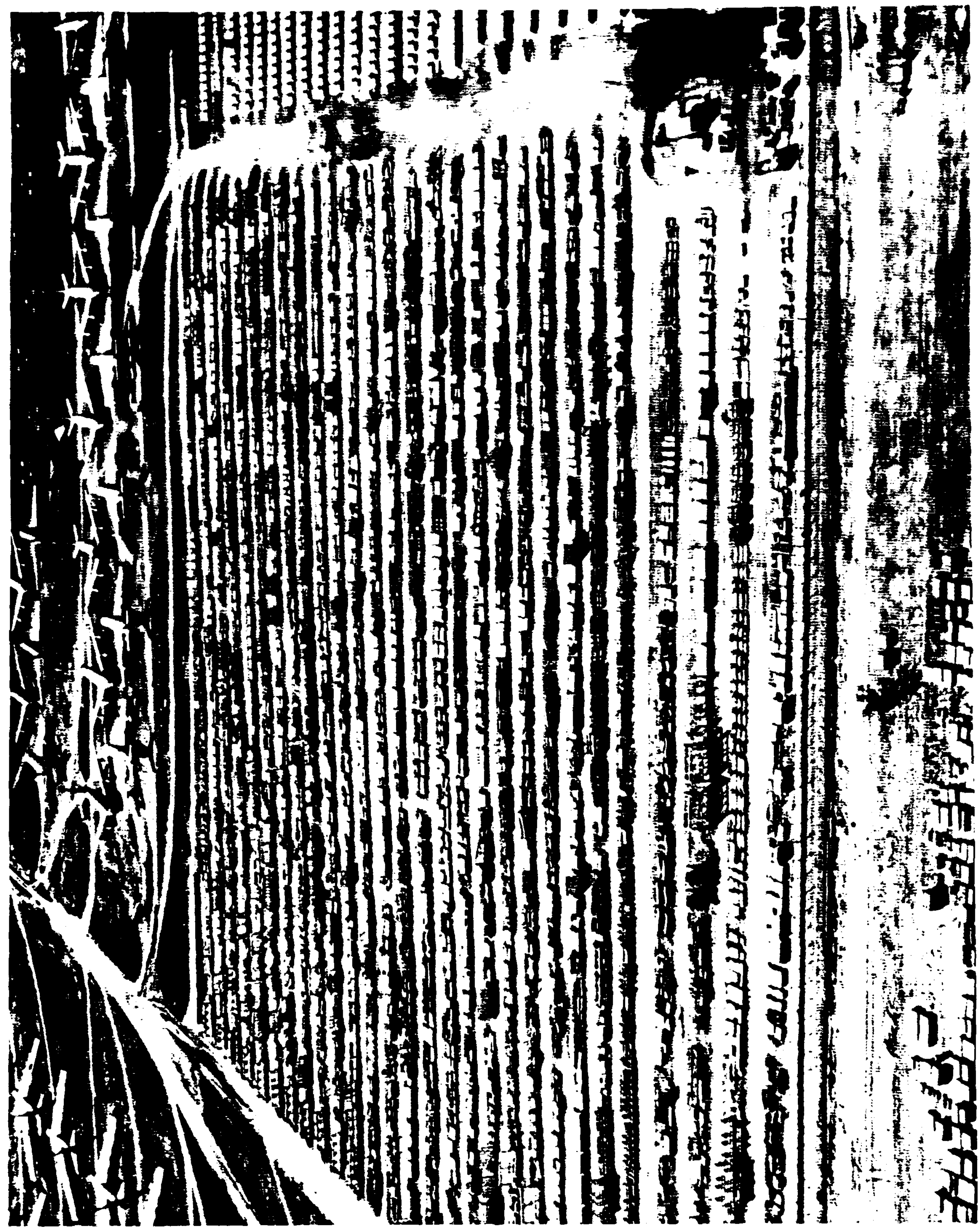
| | Inactivation Cost | 5-Year Maintenance Cost |
|---|---|---|
| CVBG | | |
| CV | 66,000K | 1,000K |
| CG | 2,800K | 750K |
| DD | 2,000K | 600K |
| FF | 1,500K | 500K |
| ARG: | | |
| LPH | 2,100K | 525K |
| LPD | 1,800K | 450K |
| LSD | 1,700K | 450K |
| LST | 1,400K | 425K |
| LKA | 1,500K | 400K |

The photo on the facing page is of Davis-Monthan AFB. Some of the more than 4,000 aircraft stored there may be seen: helicopters (left foreground), F-4s and F-14s (center), KC-135s (upper right). The city of Tucson is in the background.

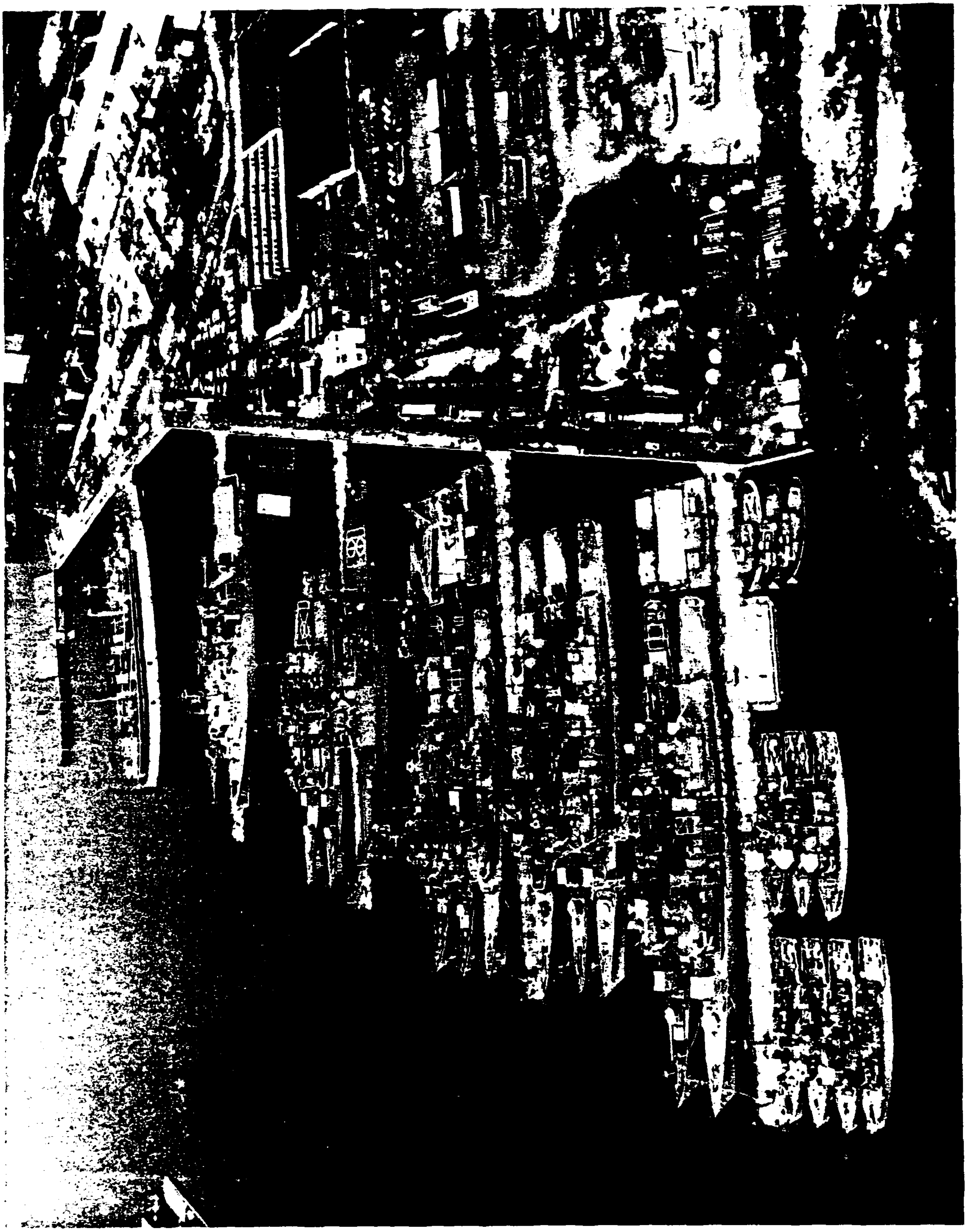


The photo at upper right on the facing page shows USAF F-4s in storage. All joints are sealed with a rubberized paint, easily strippable when cured. More than 1,000 F-4s are in storage at the 2,500+ acre facility. The lower photo shows Navy F-4s stored in bags, as well as some of the USAF F-4s (left background).

The photo on the opposite page shows all of the production tooling for the B-1B bomber. Larger pieces are sprayed with a solvent based preservative while smaller pieces are stored in sealed wooden boxes. Production tooling for the C-141 and C-5B is also being stored.



Aerial view - Portsmouth Naval Inactive Ship Maintenance Facility (NISMF) spring 1993.



The photo on the facing page depicts "Cocoons" placed over combat systems top-side equipment (here, ASROC launchers on FF 1052's in Portsmouth, Virginia). Also, sealed windows and doors/hatches, cathodic projection lines over the side, keel anchor on deck, limited access (yellow) hatches, antenna's removed.

Naval Inactive Ship Maintenance Facility (NISMF) Pearl Harbor, Circa early 1993.

# Appendix: Production Lay Away Case Study

**THE PERSHING II MISSILE SYSTEM:**

**A LESSON IN SMART INDUSTRIAL SHUTDOWN**

# INTRODUCTION

The main body of this report dealt with the layaway of major end items of equipment. However, in light of the possibility of future production shutdowns for major weapon systems, we were also asked to evaluate the use of the "smart" shutdown procedures associated with the Pershing II (PII) missile system as a case study. A "smart" shutdown entails the use of procedures beyond those inherent in the normal production termination processes. Those additional measures provide a means for future reopening of a laidaway production line.

In our evaluation, we examined two aspects of the program to terminate production of the PII missile system: what "smart" shutdown measures were used and how they would facilitate possible future production; and to what extent does (or should) a reconstitution capability remain for production of the PII. Our primary aim was to see whether any lessons learned from the PII program could be used when terminating production of other systems.

# BACKGROUND

On 8 December 1987, President Reagan and Soviet General Secretary Gorbachev signed the Intermediate Nuclear Forces (INF) Treaty, which called for the elimination of "all deployed and nondeployed ground-launched ballistic and cruise missiles with ranges between 500 and 5500 kilometers."[8] For the United States, this meant eliminating the entire the Pershing missile system from its nuclear arsenal.

The treaty divided components of missile systems into treaty-limited and treaty-controlled items. Pershing Ia treaty-limited items were to be destroyed within 18 months of the treaty's in-force date (1 June 1988), and all Pershing II treaty-limited and all deployed treaty-controlled items were to be destroyed within 36 months of the

[8] Final Report, INF Treaty Retrograde/Elimination, Pershing Project Management Office, 1991, p. 2-4.

in-force date. The following items were designated for elimination:Erector launchers

- Motor sections
- Guidance and control/adapter sections
- Warhead sections
- Radar motor sections
- Training motor sections
- Launch pad shelters

After the initial 3-year Treaty Implementation Period (TIP), possible production facilities would be inspected for the next 10 years to ensure continued adherence to the treaty's provisions, which forbids the development of missiles with similar capabilities. After 13 years (2001), satellites will be used rather than personal verification inspections to monitor treaty adherence. Thus, the 13-year period sets the initial bounds for the reconstitution plan for PII. However, emphasis centered on the initial 3-year system elimination period, June 1988 through May 1991.

Both the United States and the Soviet Union appeared dedicated to adhering to the provisions and schedules of the treaty. Nonetheless, the prudent course was to maintain the capability to reconstitute the Pershing II missile during the elimination phase as a hedge against Soviet failure to adhere to the treaty.

Accordingly, coincident with the final stages of the treaty negotiations, the Pershing Project Management Office (PPMO) initiated and managed an effort aimed at ensuring it had the capability to reconstitute PII production, if necessary.

While the rationale for developing a PII reconstitution scheme was unique to the INF Treaty, the method by which that capability was retained may be useful for future force expansion planning.

# "SMART" SHUTDOWN PROCEDURES & LESSONS LEARNED

A critical feature of the "smart" shutdown of the PII system was the early involvement of the PPMO; the prime contractor, Martin Marietta Missile Systems (MMMS); and the two major subcontractors, Loral and Hercules, in activities supporting the treaty negotiations. As a result, early

decisions were made to focus attention not only on retrograding and eliminating the system but also on providing a regeneration/reconstitution capability for the system and components that did not have to be destroyed. During the early stages of the process, PPMO decided to archive certain data and store equipment essential for reproduction of the system. After the treaty was signed, MMMS was awarded an engineering services contract to integrate the plan for system retrograding and elimination with provisions for possible restart of production.

As a result, in conjunction with the PPMO, MMMS developed two detailed plans: the *Pershing II Reuse Implementation Plan* and the *Pershing II Mothballing and Archiving Plan*. The development and implementation of these plans satisfied the immediate goal – the ability to reconstitute the PII system during the 3-year TIP. Those plans describe the steps necessary for the "smart" shutdown of a production program.

## Pershing II Reuse Implementation Plan

The *Pershing II Reuse Implementation Plan* facilitated the recapturing, redistribution, and storage of transferable mechanical and electrical parts and systems, computer software, and other technologies developed for the Pershing program to other projects. It identified and described the particular types of equipment available for future reuse and at the same time provided guidelines for possible reuse and procedures for requesting the particular items.

To facilitate reuse, recoverable (reusable) items were packaged in retention kits, and each retention kit was assigned a national stock number and identified to the end item from which the parts were removed. At the time the reuse plan was developed, PPMO estimated that approximately $1.2 billion worth of equipment would be available for reuse out of the total PII system inventory value of approximately $1.7 billion. Approximately one-third the value of the system (as measured in dollars) would be destroyed during the TIP.

Through the equipment reuse program, considerable cost savings accrued to other projects, such as the Theater Missle Defense program, because they were able to use PII components or equipment such as guidance and control systems and radars. In addition, mechanical and electrical shop sets from the PII program have been redistributed and reused. Since only approximately 10 percent of the components of these sets were unique to the PII program, they were ideally suited for use by other projects or systems.

Of the major hardware items, the Space Defense Command (SDC) owns the 106 reentry vehicles (RVs) that remained at the end of the

program (those that had not been deployed and thus did not have to be destoyed under the treaty). SDC also owns the RV retention kits that had been assembled after the treaty-limited RV airframes were destroyed. About 95 percent of the launcher kits and all motor kits are still "owned" by the PII program. However, SDC plans to use both the RV and the motor/launcher kits over the next 7 years as part of its Ground Base Intercept (GBI) program. That use saved the GBI program more than $100 million. As of September 1992, five of the RV units had been so used.

As of September 1992, approvimately $700 million of PII hardware (including the ancillary equipment previously located in firing units for which other uses had been found) had been provided to other users.

The reuse program represents a basic dichotomy within the PII reconstitution program. On one hand, the archiving program was a conscientious effort to assure the availabiity of design and production data as a starting point for reconstitution at any time during 13-year treaty period. On the other hand, most of the other reconstitution activities were oriented primariy towards the 3-year TIP. The equipment reuse program is an excellent example of the latter.

Nonetheless, the redistribution of hardware did not affect the PII reconstitution capability significantly during the TIP because the redistribution did not begin until approximately 80 percent of the treaty-limited missile items had been destroyed (approximatley December 1990). The timing of the redistribution was deliberately delayed to ensure a reconstitution capability during the early critical phases of the elimination program. Since then, 75 to 80 percent of the designated reuse items have either been shipped to reuse customers or ownership transferred to them. Some of those assets are available in case of a near-term (unlikely) reconstitution, but eventually even they are intended to be used by the new program owners.

## Pershing II Mothballing and Archiving Plan

The *PII Mothballing and Archiving Plan* provided the guidelines for preserving the applicable production and support hardware and the documentation and software for the entire 13-year treaty period. While the mothballed equipment will probably not be stored that long, the archived data should be available throughout the entire period.

### Mothballing

The plan identified the types of equipment to be stored. Primarily, that equipment would be the special tooling and special test equipment (ST/STE) used in production, either Government-furnished equipment

(GFE) or unique equipment procured with Pershing missile system funding. The plan identified equipment that was considered critical to any immediate redeployment of the PII system or essential in the manufacture of additional PII missiles.

The following manufacturing tools and test equipment were among those considered retainable for possible remanufacturing:

- Locating/holding fixtures for machining, welding, and assembly
- Special cutters
- Special hand tools
- Handling fixtures
- Transportation dollies
- Wire harness boards
- Miscellaneous potting tools
- Test fixtures, stands, and electronic equipment
- Quality acceptance tools
- Master gages

In addition, the plan provided guidelines for storing all PII-peculiar equipment in engineering development laboratories (EDLs), which existed within MMMS and supported PII development. The equipment included GFE, MMMS capital equipment, and facility equipment that would be stored for 10 years following the 3-year TIP.

The plan established the mothballing responsibilities for MMMS, subcontractors, and PPMO and provided appropriate detailed guidance for the estimating storage needs,inventorying, and creating and maintaining system files.

### *Storage of Equipment*

Beginning in 1989, management control numbers (MCNs) were established and assigned to the PII equipment and most of it was shipped to Savanna Army Depot. There it was preserved, placed in storage boxes, and stored in a warehouse dedicated exclusively to PII equipment. For all practical purposes, the equipment has not been examined or maintained since entering storage.

Because of its experience breaking out equipment from storage, MMMS was concerned with the possibility of missing or broken parts that because of the age of the equipment would be difficult to obtain and could impede future reconstitution.

In deciding upon which production equipment to store, MMMS surveyed the principal subcontractors and the 200 to 300 subtier suppliers. The primary users of GFE or direct-funded PII equipment were the prime contractor (MMMS) and the two major subcontractors, Loral (guidance and control producers) and Hercules (propulsion system). While many suppliers contributed to the data archival process, none contributed to the equipment lay away program. Since subtier suppliers usually use more generic manufacturing equipment, the PII program did not directly fund their equipment. In many cases, the subtier supplier did not even know the end product for which it was producing a component.

For several reasons, the stored equipment, which amounted to 25 to 30 percent of the PII production equipment, came almost exclusively from MMMS. The PII-funded production equipment used by Loral could be used on other projects such as the Army Tactical Missile System and various NASA-sponsored programs. Accordingly, permission was granted for Loral to retain and use the equipment as a cost-savings measure for those other projects.

Much of the tooling used by Hercules for production of the propulsion system was common to the manufacture of other systems. Accordingly, that equipment was retained by Hercules for continued use on other projects. The U.S. Army Missile Command (MICOM) retained the right to approve any disposal of that equipment.

Primarily because of environmental considerations relating to contact with PII propellent, Hercules retained the unique PII motor production equipment and was responsible for decontaminating, demilitarizing, and disposing of it by the end of September 1992.

In addition, none of the capital equipment owned by the producers and used on the PII program was included in the equipment storage plans. As the manufacturer's common capital equipment, it was retained by the owners and could be disposed of at the end of its useful life or when no longer needed. However, before its disposal, the Government must be offered the opportunity to buy and store it.

Use of the capital equipment for other production could create a problem since production of other items would be disrupted if the reconstitution of PII production were necessary. Thus, priorities among competing production lines could be an issue during reconstitution.

## Archiving

The archiving execution plan provided detailed guidance on the data to be archived and efforts for converting drawings that were not prepared on computer-aided design and manufacturing (non-CADAM) equipment to CADAM/International Graphics Exchange Standard (IGES) format. The PII technical data packages (TDPs) were to include all engineering documentation, special inspection equipment documentation, supplementary quality assurance provisions, and software documentation formally released for the Pershing system.

The plan described the transfer of custodianship of the TDPs, which include instructions for shipping documents that were not in an electronic data base, and specified the maintenance responsibilities for the electronic data base.

Approximately 24,000 TDP documents were to be shipped to PPMO. That documentation, from MMMS, subcontractors, and suppliers, consisted of the following types and approximate quantities:

- 8,500 manufacturing process plans
- 300 manufacturing processes
- 1,500 numerical control tapes
- 7,330 numerical control set-up sheets
- 3,600 tool design drawings
- 550 functional test procedures

Provisions were made to ensure that all proprietary data and documentation would be archived in a designated area at MMMS for the duration of the treaty. All proprietary software data was to be copied and stored in an environmentally controlled area.

The plan specified the manner in which MMMS was to archive the data, with appropriate PPMO review during each phase of the operation. In addition, the plan also described the manner in which subcontractors and suppliers would participate in the archival process.

The plan assigned responsibilities and established milestones for performing each task. It was a comprehensive plan that ensured the availability of appropriate data for renewed PII production, if necessary.

Even though technology will improve while an item is out of production, documentation of the existing item can serve as a starting point for renewed production. However, a basic tenet of reconstitution

planning is that the longer an item is out of production, the greater the impact of modern technology upon that product. With each passing year, the value of the project archives will decline.

Under circumstances in which product development (modernization) continues, although production has ended, periodic review and updating of the archives could assist in maintaining a more viable reconstitution capability.

Normally MMMS retains archived data on terminal projects for 4 years. While the PII archiving program was extensive, the longer time period it had to satisfy (13-years) and the absence of a continuing development program for the missile system will greatly reduce the value of those archives by 2001.

## Continued Value of the Archiving & Mothballing Program

### Impact of Modernization

The MMMS and MICOM managements appear to differ on the impact of technology improvements since termination of the program. Some MICOM representatives remarked that the technology used in the PII system was state of the art and would remain such through the turn of the century. On the other hand, a rule of thumb postulated by MMMS personnel was that any electronic components more than 5 years old would have to be redesigned to reflect new technology. They remarked that to replace even damaged components in retained system parts would require redesign since several electronic components used in the PII system are no longer in production because of advancements in both the components and manufacturing processes.

System modernization may be a major factor in the current residual reconstitution capability of the PII system. Mitigating some of the considerations about any future reconstitution of PII is the fact that the system is currently 10 years old and its technology is even older. At the time of the INF Treaty, several PII system modernization efforts were underway for major modifications to the launcher assembly, ground support hardware, and the ground launch computer system.

An additional consideration is the fact that MMMS is not investing its own funds to maintain or develop technology for the next generation of intermediate range missiles. With no foreseeable need for such missiles, neither industry nor Government is willing to invest in developing such technology. In addition, design or development of an intermediate range

missile is prohibited by the treaty. Accordingly, nothing appears to being done to develop a follow-on missile.

A consistent view expressed by several interviewees was that future production of a missile system with similar characteristics to the PII would probably be a smaller, more technologically advanced missile. *The next intermediate range nuclear missile will not be a PIIa.*

Thus, while the archiving and mothballing programs provided a reconstitution capability during the TIP, their contiunued value diminishes considerably with each passing year.

## Other Impacts On PII Reconstitution Capability

### Availability of Production Space

From the MMMS point of view, reconstituting PII would not be hindered by the lack of production space because MMMS has adequate space in its current facilities. However, the PII system was not assembled in CONUS facilities; rather, the components were shipped to Germany for final assembly and modification of the Pershing Ia missiles.

### Type Classification as "Obsolete"

An interesting issue identified during our study was the effect of classifying the PII system as "obsolete." One of the driving forces behind a classification action for obsolescence is usually the imperative to declare items excess if they no longer are required. Since the PII has been virtually eliminated as a system within the Army, that appears to be a rational action.

Since about 95 percent of the PII spare and repair parts had already been declared "excess" during the missile elimination phase, excessing spares is not a major factor in deciding to classify the PII system as obsolete. As PII components were destroyed, the need for the spare and repair parts diminished and then disappeared. Item managers took actions to declare as excess those parts for which there no longer was a requirement. Accordingly, for the PII, the type classification process does not materially affect spares and repair parts.

Further, the classification result would not affect the status of the archived production/system documentation. Since that material is already stored by either the Government or MMMS, nothing needs to be done with the documentation through the life of the treaty, i.e., 2001,

especially since the archived material incurs essentially no recurring annual cost.

The classification decision, however, may certainly affect the status of the stored production equipment, especially when considering an apparent desire by Depot Systems Command to free up storage space. Thus, with continued free storage at the Savanna Army Depot in jeopardy, a declaration of the PII system as "obsolete" would make unnecessary the retention of its production equipment.

*The possible impacts of such classification actions need to be considered when developing and monitoring reconstitution plans. Up-front guidance on item management for spares and repair parts may be necessary.*

### Continued Storage of Production Equipment

Continued storage of PII production equipment at the Savanna Army Depot appear contingent on two other factors. First, future consolidation and elimination of Army depots will result in reduced storage space, thus placing a premium on remaining space and thereby increasing the pressure to make most economic use of the remaining facilities. Second, considerable Army equipment and materiel are expected to require depot storage because of the force downsizing and units returning from overseas. As a result, covered storage space will be at a premium in the Army. Accordingly, we expect efforts to free up protected storage space at depots such as the Savanna Army Depot.

The decreasing availability of Government storage space will make the storage of production equipment more costly in the future since it may have to be provided by the manufacturers. Because the likelihood of a near-term need to reconstitute the PII production line is small, PII production equipment will probably be declared excess rather than continued in storage at the manufacturers at a high cost.

## Smart Shutdown Costs

Martin Marietta proposed to package, preserve, and store the PII production equipment for an initial cost of $3 million and an annual storage fee of $10/square foot for the term of the contract. The PPMO believed those costs to be excessive and investigated alternative storage proposals.

The alternative it accepted was one proposed by the Savanna Army Depot. Working through the Army's Depot System Command, the PPMO issued a contract to the Savanna Army Depot to package, preserve, and store the PII production equipment for $600,000.

The total cost to provide a reconstitution capability is believed to be about $12 million. That cost includes approximately $2.3 million for developing the two plans and the remaining $9.7 million for archiving, procuring software and hardware for the archiving program, and preserving, packaging, transporting, and storing the equipment.

# CASE STUDY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

We found the decisions made and procedures used in ending production of the PII to be an excellent example of a smart shutdown of a production program. Those decisions provided the bases for a legitimate reconstitution capability during the 3-year TIP of the INF Treaty (the intent of the reconstitution program for the PII). However, even those actions did not provide an immediate restart capability. It would still have taken approximately 2 to 3 years before new missiles could be produced. The "smart" shutdown provided a head start for reinitiating the production of the PII system during a fairly limited period.

The layaway program planning was initiated partially as a hedge against possible Soviet abrogation of the treaty during the TIP, which was completed in May 1991. Since then, considerable changes have taken place in the geopolitical, strategic, and military environments – the dissolution of the Soviet Union, elimination of the Warsaw Pact, and the reunification of Germany, to name but three. Consequently, no PII reconstitution need is foreseen.

Archiving the documentation and mothballing the equipment resulted in a viable reconstitution capability during TIP, which was the program's goal. In addition, the archival plan provided the means for retrieving system design and production data for the entire 13 years covered by the visual inspection phase of the Treaty. However, plans and actions subsequent to the TIP, especially those for the equipment reuse program, have dramatically reduced the PII's reproduction capability but have not diminished the validity of the "smart" shutdown planning concept.

However, the primary value of a smart shutdown is realized in the relatively near term (approximately 3-5 years) for high tech systems. Because of changing technology, the value of a layaway program diminishes over time. At the time PII components and production equipment were stored, they were state of the art. However, with rapidly changing technology, especially in the electronics area, the value of those components has diminished. The useful shelf-life of many of the PII electronic components was estimated as 5 years. Even in the absence of a treaty, changes and improvements in components and manufacturing processes since 1987 would require redesign to repair or replace

components for a reconstituted system. Thus, today the PII cannot be rebuilt as it was configured in 1987; an improved or hybrid missile (smaller, more sophisticated) would be produced to meet future threats.

Active leadership by the program management office, involving the prime contractor, major subcontractors, and subtier vendors, is critical. While production termination procedures are standard to any major weapon systems program, additional procedures are necessary to provide the capability to meet force expansion needs.

Before terminating production, a system must be assessed to determine whether a need exists for retaining a production capability. This should be done by the program manager in coordination with Service requirements and operations planners, e.g., for the Army, DCSOPS. In the case of the PII system, DOD decided to create such a capability as a hedge against possible abrogation of the treaty by the Soviet Union. Such a decision may not be easily reached in the future in the absence of a specific threat. Once the requirement to retain a reconstitution capability has been identified, the program management team must involve the prime contractor, major subcontractors, and subtier suppliers in identifying and developing the critical nodes for restarting production. Specialized production techniques, unique tooling, system documentation, and critical personnel skills must be identified by the producers.

*We recommend that in those cases where a decision is made to layaway the production capability for a particular system a personnel locator/recall system for critical skill personnel be estabished as part of the layaway program.*

Currently, manufacturers are able relate production equipment to systems worked upon, an ability especially useful for common capital equipment used in various production lines. The manufacturers also are able to track employees by the systems they work on. However, they do not have a system for keeping track of employees who have retired or left the company. During a period of serious retrenchment of the defense industrial base, the need for such a locator system should be apparent. Refreshing critical skills takes less time than training new personnel. Accordingly, a system listing critical design, production, and management personnel by skills could be an important factor in being able to reconstitute critical or unique production nodes and could facilitate meeting force expansion needs.

*Lay away of production equipment should consider production of both the major end item and ancillary equipment.*

Although the PII production termination process focused on the missile system, ground support equipment also received attention. For force expansion purposes, the complete weapon system, not just the major

end item, must be considered. The unique contributions of important ancillary equipment must also be considered.

*Since entire production lines will not be stored, force expansion planning should consider disruptions to other programs.*

In the case of the PII system, only 25 to 35 percent of the manufacturing equipment was actually placed in storage. Both common capital equipment and PII-procured items that could be used on other projects were not stored but rather were used on other production lines. Accordingly, to reconstitute PII production would require disrupting other production lines or procuring additional production equipment. Planners must consider the time to procure such equipment and the relative importance of competing production lines. Production equipment owned by the manufacturer may also be declared excess. In that case, the Government must ensure that the replacement equipment is useful. Otherwise it may have to procure the equipment the manufacturer declared excess to retain a viable production capability.

*The loss of subtier vendors may be a major concern, therefore, DoD should identify the critical or unique capabilities they offer.*

During the PII production closedown process, MMMS queried approximately 200 to 300 subtier suppliers about their unique contributions to the PII program. While their PII-related project documentation was archived, it was not necessary to lay away any of their equipment. Because the project management office may not be acutely aware of the condition of the subtier, it must rely upon the prime and major subcontractors to evaluate the criticality of subtier vendors. Interestingly, MMMS did not view the potential loss of subtier vendors with much alarm since the entrance and exit of such vendors has been a normal aspect of its defense business.

As part of the production termination process, program/project managers should require the prime and major subcontractors to identify critical subtier vulnerabilities that may need attention to ensure the ability to meet possible force expansion needs. Guidance to program/project managers concerning production termination considerations should be codified and included in DoD Instruction 5000.2, Defense Acquisition Management Policies and Procedures.

*Archived and stored material should be reviewed periodically.*

Because of the danger of obsolescence, a periodic review process for archived and stored material should be established. The review would enable DoD to keep pace with changing technologies for possible insertion during reconstitution. No such program or process exists for the PII system. Under other circumstances (i.e., programs that are not being shutdown by treaties), DoD can remain aware of changing technologies

through either product improvement or advanced development projects. Neither option was available for PII. However, if serious concerns about possible reconstitution arise, the effect of technologies and modernization impediments are important.

*We recommend that management of laidaway production equipment be specifically assigned within the respective system acquisition commands and the Defense Logistics Agency.*

Management of the stored assets, including decisions concerning possible reuse for other projects, should reside within the respective system acquisition commands and the Defense Logistics Agency. To the extent necessary, specific "system deactivation offices" could be established, conceivably out of the staffs of the terminating programs. These offices could supplement the terminated program management offices, serve as a repository of production termination and layaway expertise, assist in system force expansion planning, contain core project managment capabilities for force expansion, and coordinate system component or production equipment reuse programs.

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This research report describes the issues regarding equipment becoming excess due to force reductions, particularly regarding the question of whether this equipment would be useful as the basis for a future force build-up. The issues addressed include the availability of equipment, the anticipated timing of such a build-up, the new force size in relation to the storage program, the costs associated with storage programs, the impact of technology as it relates to the rate of obsolescence, and the policies which the Department of Defense should pursue. A related issue is whether production equipment and facilities for selected major end items should also be laid away. The report concludes that laying away production equipment and facilities to preserve the capability to produce old equipment is generally not recommended. In the case of equipment itself, an argument can be made that there are legitimate reasons for doing so, but that the Department of Defense needs to first explicitly decide whether retaining the capability such storage programs would provide ought to be part of our national military strategy.

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